## AMENDMENT TO THE CLAIMS

Please amend claims 1, 7, 11-17 and 23 as follows:

- 1. (Presently Amended) An apparatus disc storage system having a servo loop for positioning a head over a disc, the servo loop comprising:
  - a voice coil motor actuator configured to move the head in response to a received servo control signal;
- a sensor, located in the head, which is configured to sense servo information located on the disc and produce a servo signal therefrom, the servo signal is combined with a reference signal to produce a position error signal;
- a servo controller configured to receive the position error signal and to responsively produce the servo control signal, the servo controller comprising:
- a drive signal generator configured to receive the position error signal and to responsively produce a driving energy signal; and
- a vibration damping circuit configured to receive the driving energy signal and to responsively produce the servo control signal; and
  - a vibration damping circuit coupled to receive a driving energy signal; and
  - a real-time adaptive loop shaping circuit configured to detect vibration energy in thea position error signal in real-time, and to responsively adjust, in real-time, at least one parameter of a transfer function of the vibration damping circuit to reduce vibrations at different frequencies in the driving energy signal received by the vibration damping circuit.
- 2.(Original) The apparatus of claim 1 wherein the vibration

damping circuit includes a notch filter to damp vibrations at high frequency resonance modes, and wherein the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter.

- 3.(Original) The apparatus of claim 2 wherein the real-time adaptive loop shaping circuit adjusts the depth of the notch filter by modifying a gain of the notch filter.
- 4.(Original) The apparatus of claim 2 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect vibrations at high frequency resonance modes in the position error signal.
- 5.(Original) The apparatus of claim 1 wherein the vibration damping circuit includes a non-repeatable runout compensator to cancel non-repeatable runout disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect non-repeatable runout disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.
- 6.(Original) The apparatus of claim 5 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect non-repeatable runout disturbances in the position error signal.
- 7. (Presently Amended) The apparatus of claim 1 wherein the vibration damping circuit includes a rotational vibration compensator to cancel rotational vibration disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect rotational vibration disturbances in the position error

signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runoutrotational vibration compensator.

- 8.(Original) The apparatus of claim 7 wherein the real-time adaptive loop shaping circuit includes a low-pass filter to detect rotational vibration disturbances in the position error signal.
- 9.(Original) The apparatus of claim 1 wherein the vibration damping circuit includes a plurality of disturbance adjustment compensators to cancel vibration disturbances at different frequency ranges, and wherein the real-time adaptive loop shaping circuit is configured to detect vibration disturbances at the different frequency ranges in the position error signal and to responsively adjust at least one parameter of a transfer function of at least one of the plurality of disturbance compensators.
- 10. (Original) The apparatus of claim 1 wherein the real-time adaptive loop shaping circuit includes a learning component that adjusts a speed of adaptation of the servo loop.
- 11. (Presently Amended) A method of maintaining stability in a servo loop used for positioning a head over a disc in a disc drive, the servo loop having a voice coil motor actuator and a servo controller that controls the voice coil motor actuator, the method comprising:
  - (a) generating a servo signal based on the position of the head over the dise;
  - (b) generating an actuator control signal for driving the voice coil motor actuator based on a position error signal, wherein the position error signal is determined by combining the serve signal with a reference signal;
  - $\frac{(e)}{(a)}$  detecting vibration energy in  $\frac{1}{2}$  position error

signal in real-time; and

 $\frac{(d)}{(b)}$  adjusting, in real-time, at least one parameter of a transfer function of the servo controller to attenuate the vibration energy detected in step  $\frac{(e)}{(a)}$  at different frequencies.

- 12. (Presently Amended) The method of claim 11 wherein the detecting vibration energy step (e)(a) includes detecting vibrations at high frequency resonance modes, and wherein the adjusting step (e)(b) includes adjusting a depth of a notch filter of the servo controller to reduce vibrations at high frequency resonance modes.
- 13.(Presently Amended) The method of claim 11 wherein the detecting vibration energy step  $\frac{(e)}{(a)}$  includes detecting non-repeatable runout disturbances, and wherein the adjusting step  $\frac{(e)}{(b)}$  includes adjusting at least one parameter of a transfer function of a non-repeatable runout compensator of the servo controller to reduce non-repeatable runout disturbances.
- 14. (Presently Amended) The method of claim 11 wherein the detecting vibration energy step  $\frac{(e)}{(a)}$  includes detecting rotational vibration disturbances, and wherein the adjusting step  $\frac{(e)}{(b)}$  includes adjusting at least one parameter of a transfer function of a rotational vibration compensator of the servo controller to reduce rotational vibration disturbances.
- 15. (Presently Amended) The method of claim 11 wherein the detecting vibration energy step  $\frac{(c)}{(a)}$  and the adjusting at least one parameter step  $\frac{(d)}{(b)}$  is carried out by a real-time adaptive loop shaping circuit.

- 16.(Presently Amended) A disc drive for storing information on a disc, the disc driveservo loop comprising:
  - a servo loop for positioning a head over the disc, the servo loop including a servo controller and a voice coil motor actuator, the voice coil motor actuator is configured to move the head in response to a servo control signal generated by the servo controller; and
  - a real-time adaptive loop shaping means for attenuating disturbances in the servo loop.
- 17. (Presently Amended) The apparatus of claim 16 wherein: the serve loop further comprises:
- a sensor, located in the head, which is configured to sense servo information located on the disc and produce a servo signal therefrom, the servo signal is combined with a reference signal to produce a position error signal; and
  - the real-time adaptive loop shaping means comprises a realtime adaptive loop shaping circuit adapted to:
    - detect vibration energy in thea position error signal in real-time, and to responsively adjust, in real-time, at least one parameter of a transfer function of a vibration damping circuit of the servo controller to reduce vibrations at different frequencies in the servo loop.
- 18.(Original) The apparatus of claim 17 wherein the vibration damping circuit includes a notch filter to damp vibrations at high frequency resonance modes, and wherein the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter.

- 19. (Original) The apparatus of claim 18 wherein the real-time adaptive loop shaping circuit adjusts the depth of the notch filter by modifying a gain of the notch filter.
- 20.(Original) The apparatus of claim 18 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect vibrations at high frequency resonance modes in the position error signal.
- 21. (Original) The apparatus of claim 17 wherein the vibration damping circuit includes a non-repeatable runout compensator to cancel non-repeatable runout disturbances, and wherein the realtime adaptive loop shaping circuit is configured to detect non-repeatable runout disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.
- 22.(Original) The apparatus of claim 21 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect non-repeatable runout disturbances in the position error signal.
- 23. (Presently Amended) The apparatus of claim 17 wherein the includes circuit damping а rotational compensator to cancel rotational vibration disturbances, wherein the real-time adaptive loop shaping circuit is configured to detect rotational vibration disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout rotational vibration compensator.
- 24.(Original) The apparatus of claim 23 wherein the real-time adaptive loop shaping circuit includes a low-pass filter to detect

rotational vibration disturbances in the position error signal.

25. (Original) The apparatus of claim 17 wherein the vibration damping circuit includes a plurality of disturbance adjustment compensators to cancel vibration disturbances at different frequency ranges, and wherein the real-time adaptive loop shaping circuit is configured to detect vibration disturbances at the different frequency ranges in the position error signal and to responsively adjust at least one parameter of a transfer function of at least one of the plurality of disturbance compensators.

26. (Original) The apparatus of claim 17 wherein the real-time adaptive loop shaping circuit includes a learning component that adjusts a speed of adaptation of the servo loop.